List of Related Art for IDS

Japanese Patent Laid-Open Publication	File Date	Publication Date	Comments
JP-A-No. 11-247650	Mar.4,'98	Sep.14,'99	A SOx catalyst is provided on an exhaust passage upstream of a NOx catalyst so as to prevent inflow of SOx into the NOx catalyst and therefore prevent the sulfur poisoning of the NOx catalyst. If the amount of SOx retained by the SOx catalyst increases, it becomes rather difficult for the catalyst to take up and retain SOx from incoming exhaust gas, and the amount of SOx present in exhaust gas flowing out of the SOx retainer agent tends to increase.
JP-A-No.2000-145436	Nov.9,98	May.26,00	A SOx absorbent is disposed in an exhaust passageway upstream of a NOx absorbent. A bypass is provided for bypassing the exhaust passageway extending between the SOx absorbent and the NOx absorbent. If the engine load is higher than an allowable maximum load when the amount of SOx absorbed in the SOx absorbent exceeds a set value, release of SOx from the SOx absorbent is prevented by prohibiting the temperature of the SOx absorbent from becoming higher than the release temperature and prohibiting the air-fuel ratio of exhaust gas flowing into the SOx absorbent from becoming rich of stoichiometry, and exhaust gas is caused to

			flow into the NOx absorbent without flowing into the bypass.
JP-A-No. 2000-161045	Nov.25,'98	Jun.13,'00	If an ECU determines that a predetermined amount of SOx has been absorbed in a NOx catalyst and it is the time to release SOx, the ECU executes a stoichiometric control of the exhaust air-fuel ratio and an exhaust gas temperature control of maintaining a high exhaust gas temperature equal to or higher than a predetermined temperature, that is, executes a high-temperature stoichiometric control, in order to release SOx from the NOx catalyst (SOx releasing process). However, if the running speed of the vehicle detected by a vehicle speed sensor is lower than or equal to a lower-limit speed, that is, if the vehicle is at a stop or in a very low speed running state, the ECU stops the high-temperature stoichiometric control, and performs a low-temperature stoichiometric control of controlling the exhaust gas temperature at or below a release reduction temperature while maintaining a stoichiometric exhaust air-fuel ratio, so as to stop the release of SOx from the NOx catalyst and stop the SOx releasing process.

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PATENT ABSTRACTS OF JAPAN

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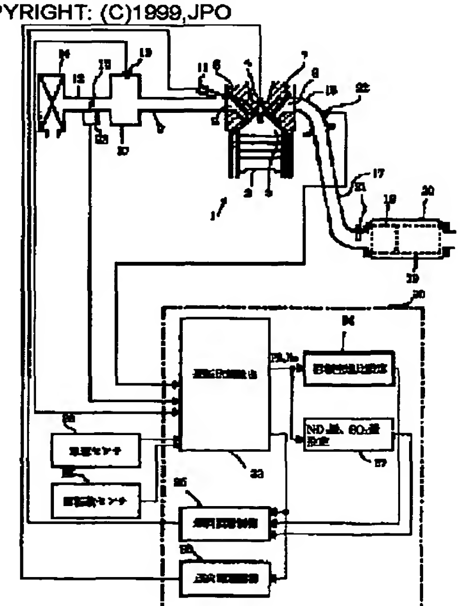
(72) Inventor: **TAKAHASHI TOSHIKATSU**
SUGIURA KENJI

(54) **EXHAUST EMISSION CONTROL DEVICE OF INTERNAL COMBUSTION ENGINE**

(57) Abstract:

PROBLEM TO BE SOLVED: To efficiently eliminate SOx according to its characteristic by controlling a fuel injection means to make the air fuel ratio supplied to an internal combustion engine more rich than the air fuel ratio when NOx is reduced in order to reduce SOx which has strong reaction force so that reduction release from a catalyst is not easy.

SOLUTION: During the operation of an engine 1, the absorbed amounts of NOx and SOx absorbed in NOx catalyst 19 and SOx catalyst 18 are respectively estimated by an estimating party 37 in an ECU 30 to first determine whether SOx is saturated or not, and if NO, secondary it is determined whether NOx is saturated or not. If saturation of NOx is determined, making air fuel ratio rich and its execution time for eliminating NOx are decided to make rich. On the other hand, in the case where saturation of SOx is determined, making air fuel ratio rich and its execution time for eliminating SOx are calculated, and in the case where the temperature of a catalyst is below the reference temperature effective for eliminating SOx, it enters NOx elimination process. However, in the case where the temperature of a catalyst is above the reference temperature, the ratio is made rich.



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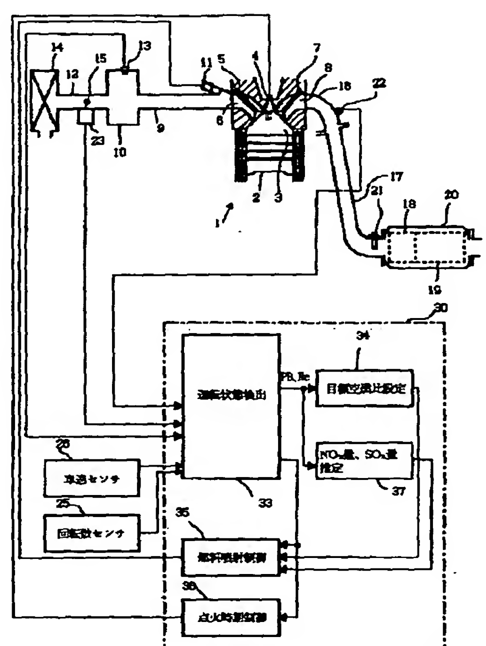
(54)【発明の名称】　内燃機関の排気浄化装置

(57)【要約】

【課題】　排気ガス中に含まれるＮＯ$_X$およびＳＯ$_X$を効果的に除去する排気ガス浄化装置を提供する。

【解決手段】内燃機関の排気系に設けられリーン空燃比での運転時にＮＯ$_X$を吸蔵するＮＯ$_X$触媒、およびＮＯ$_X$触媒の上流に設けられリーン時にＳＯ$_X$を吸収するＳＯ$_X$触媒を有する内燃機関の排気浄化装置において、ＳＯ$_X$触媒に吸収されたＳＯ$_X$を還元するためＮＯ$_X$触媒に吸収されたＮＯ$_X$を還元させるためのリッチスパイクより濃いリッチスパイクを実施する。また、内燃機関の吸入空気量および機関の回転数に基づいてＮＯ$_X$触媒に吸蔵されたＮＯ$_X$の量およびＳＯ$_X$触媒に吸収されたＳＯ$_X$の量の飽和を推定し、これに応じてリッチスパイクを実施する。ＮＯ$_X$除去のための制御とＳＯ$_X$除去のための制御とを個別に実施するので、新たなセンサを設けることなくＮＯ$_X$およびＳＯ$_X$の特徴に合わせた処理が行われ、触媒の機能を効率的に発揮させることができる。



【特許請求の範囲】

【請求項１】内燃機関の排気系に設けられリーン空燃比での運転時にNO_xを吸収するNO_x触媒、および該リーンNO_x触媒の上流に設けられリーン時にSO_xを吸収するSO_x触媒を有する内燃機関の排気浄化装置において、
前記内燃機関に燃料を供給する燃料噴射手段と、
前記NO_x触媒に吸収されたNO_xを還元させるため前記内燃機関に供給する空燃比を理論空燃比よりリッチにし、前記SO_x触媒に吸収されたSO_xを還元するため前記内燃機関に供給する空燃比をNO_xを還元させる時の空燃比よりリッチにするよう前記燃料噴射手段を制御する燃料噴射制御手段と、
を備えることを特徴とする内燃機関の排気浄化装置。

【請求項２】内燃機関の排気系に設けられリーン空燃比での運転時にNO_xを吸収するNO_x触媒、および該リーンNO_x触媒の上流に設けられリーン時にSO_xを吸収するSO_x触媒を有する内燃機関の排気浄化装置において、
前記内燃機関の負荷および機関の回転数に基づいて前記NO_x触媒に吸収されたNO_xの量および前記SO_x触媒に吸収されたSO_xの量をそれぞれ推定する推定手段と、
前記内燃機関に燃料を供給する燃料噴射手段と、
前記推定手段により推定されたNO_xの量が飽和に近づいた状態が判定されることに応じて、NO_xを除去するに適した時間、内燃機関に供給する空燃比を理論空燃比よりリッチにし、前記推定手段によりSO_xの量が飽和に近づいた状態が判定されることに応じて、SO_xを除去するに適した時間、内燃機関に供給する空燃比を理論空燃比よりリッチにするよう前記燃料噴射手段を制御する噴射燃料制御手段と、
を備えることを特徴とする内燃機関の排気浄化装置。

【請求項３】内燃機関の排気系に設けられリーン空燃比での運転時にNO_xを吸収するリーンNO_x触媒を有する内燃機関の排気浄化装置において、
前記内燃機関の負荷および機関の回転数に基づいて前記リーンNO_x触媒に吸収されたNO_xの量およびSO_xの量をそれぞれ推定する推定手段と、
前記内燃機関に燃料を供給する燃料噴射手段と、
前記推定手段により推定されたNO_xの量が飽和に近づいた状態が判定されることに応じて、NO_xを除去するに適した時間、内燃機関に供給する空燃比を理論空燃比よりリッチにし、前記推定手段によりSO_xの量が飽和に近づいた状態が判定されることに応じて、SO_xを除去するに適した時間、内燃機関に供給する空燃比を理論空燃比よりリッチにするよう前記燃料噴射手段を制御する噴射燃料制御手段と、
を備えることを特徴とする内燃機関の排気浄化装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は、リーン空燃比で運転されるリーンバーン内燃機関の排気浄化装置に関し、具体的には、内燃機関で発生するNO_xおよびSO_xの浄化機能を向上させる排気浄化装置に関する。

【０００２】

【従来の技術】リーン空燃比で燃料を燃焼させるようにした内燃機関においては、リーン時に排出されるNO_xを吸着または吸蔵し、リッチまたは理論空燃比時に、吸着または吸蔵したNO_xを還元浄化するリーンNO_x触媒が使用される。リーンNO_x触媒には、次の２つの方式のものがある。

【０００３】第１の方式のものは、NO_x吸着方式または直接分解方式と呼ばれるもので、高融点貴金属をゼオライトやアルミナに担持させて形成される。貴金属としてＰｔ、Ｉｒ、Ｒｈを複合化させることにより、Ｐｔ単独に比べリーンNO_x浄化効果および耐熱性を向上させることができると報告されている（「自動車原動機の環境対応技術」朝倉書店、1997年7月10日、p60）。この触媒のNO_x浄化作用は、次のように考えられている。燃焼ガスに含まれるNO_xが貴金属の表面に吸着されるが、ＨＣ濃度が高くなると、NO_xの分解によって貴金属表面に生成される酸素がＨＣで還元される。こうしてNO_xの分解が促進され、浄化される。この触媒は、リーンNO_x浄化特性だけでなく、一般的な三元触媒特性も有している。

【０００４】第２の方式のものは、NO_x吸蔵還元型と呼ばれるもので、アルミナなどの担体にＰｔ系貴金属とＢａ、Ｌａなどのアルカリ、アルカリ土類および希土類の塩が高分散担持されたものである。この触媒によるとリーン時に排出されるＮＯがＰｔ表面上でNO_2に酸化され、吸蔵成分に硝酸塩（NO_3^-）として吸蔵される（前掲「自動車原動機の環境対応技術」p61）。次に、空燃比を理論空燃比からリッチに制御すると、ＨＣ、ＣＯ、H_2などのガスにより吸蔵NO_xが還元され除去される。この触媒も一般的な三元触媒特性をも有している。

【０００５】このようにリーンNO_x触媒は、リーン時に生成されるNO_xを吸着または吸蔵し、リッチ時に分解または還元して除去するものである。このようにNO_xを吸着または吸蔵して保持することを吸収と呼ぶ。

【０００６】ところが燃料および内燃機関の潤滑油にはイオウが含まれているので、排気ガス中にはSO_xが含まれている。このSO_xは、NO_xとともにリーンNO_x触媒に吸収されるが、NO_x除去のために空燃比をリッチにしても除去することができない。したがって、リーンNO_x触媒に吸収されるSO_xの量が次第に増大し、NO_xの吸収能力を低下させる。

【０００７】この問題に対応するものとして、特開平６－２２９２３０号公報には、内燃機関の排気系においてリーンNO_x触媒の上流にSO_x吸収剤（以下SO_x触媒

という）を配置し、リーンバーン状態においては排気ガス中のSO_xをSO_x触媒に吸収するとともに排気ガス中のNO_xをリーンNO_x触媒に吸収することが記載されている。このSO_x触媒は、排気ガスの空燃比がリーンであるときにSO_xを吸収し、排気ガスがリッチになると吸収したSO_xを酸化還元して放出する。この公報に記載される手法は、空燃比をリッチにする際、SO_x触媒においてＨＣが消費されて減少するリッチの度合いを求めて、その分リッチの度合いを増大させて排気ガスをリッチに制御することを提案している。

【０００８】

【発明が解決しようとする課題】特開平６－２２９２３０号公報の手法は、SO_x触媒からSO_xを放出させるタイミングとNO_x触媒からNO_xを放出させるタイミングおよびリッチの度合いについては何ら考慮されていない。そこで、この発明は、排気ガス中に含まれるNO_xおよびSO_xを効果的に除去する排気ガス浄化装置を提供することを目的とする。

【０００９】

【課題を解決するための手段】請求項１の発明は、上記の課題を解決するため、内燃機関の排気系に設けられリーン空燃比での運転時にNO_xを吸収するNO_x触媒、および該リーンNO_x触媒の上流に設けられリーン時にSO_xを吸収するSO_x触媒を有する内燃機関の排気浄化装置において、内燃機関に燃料を供給する燃料噴射手段と、NO_x触媒に吸収されたNO_xを還元させるため前記内燃機関に供給する空燃比を理論空燃比よりリッチにし、前記SO_x触媒に吸収されたSO_xを還元するため内燃機関に供給する空燃比をNO_xを還元させる時の空燃比よりリッチにするよう燃料噴射手段を制御する燃料噴射制御手段と、を備える構成をとる。

【００１０】この発明によると、NO_xおよびSO_xの触媒への吸収および還元特性の相違に着目し、反応力が強く触媒からの還元放出が容易でないSO_xを還元するためにNO_x還元のためのリッチな空燃比より一層リッチな空燃比の燃料を、NO_x還元のためのリッチ化とは異なる時間に供給するので、SO_xをその特性に応じて効率的に除去することができる。

【００１１】請求項２の発明は、内燃機関の排気系に設けられリーン空燃比での運転時にNO_xを吸収するNO_x触媒、および該リーンNO_x触媒の上流に設けられリーン時にSO_xを吸収するSO_x触媒を有する内燃機関の排気浄化装置において、内燃機関の負荷および機関の回転数に基づいて前記NO_x触媒に吸収されたNO_xの量および前記SO_x触媒に吸収されたSO_xの量をそれぞれ推定する推定手段と、内燃機関に燃料を供給する燃料噴射手段と、推定手段により推定されたNO_xの量が飽和に近づいた状態が判定されることに応じて、NO_xを除去するに適した時間、内燃機関に供給する空燃比を理論空燃比よりリッチにし、推定手段によりSO_xの量が飽和に近づいた状態が判定されることに応じて、SO_xを除去するに適した時間、内燃機関に供給する空燃比を理論空燃比よりリッチにするよう燃料噴射手段を制御する噴射燃料制御手段と、を備える構成をとる。

【００１２】請求項２の発明は、内燃機関の吸入空気量および機関の回転数に基づいてNO_x触媒に吸蔵されたNO_xが飽和する状態およびSO_x触媒に吸収されたSO_xが飽和する状態を推定し、NO_x除去のための制御とSO_x除去のための制御とを個別に実施するので、新たなセンサを設けることなくNO_xおよびSO_xの特徴に合わせた処理が行われ、触媒の機能を効率的に発揮させることができる。

【００１３】請求項３の発明は、内燃機関の排気系に設けられリーン空燃比での運転時にNO_xを吸収するリーンNO_x触媒を有する内燃機関の排気浄化装置において、内燃機関の負荷および機関の回転数に基づいて前記NO_x触媒に吸収されたNO_xの量およびSO_xの量をそれぞれ推定する推定手段と、内燃機関に燃料を供給する燃料噴射手段と、推定手段により推定されたNO_xの量が飽和に近づいた状態が判定されることに応じて、NO_xを除去するに適した時間、内燃機関に供給する空燃比を理論空燃比よりリッチにし、推定手段によりSO_xの量が飽和に近づいた状態が判定されることに応じて、SO_xを除去するに適した時間、内燃機関に供給する空燃比を理論空燃比よりリッチにするよう燃料噴射手段を制御する噴射燃料制御手段と、を備える構成をとる。

【００１４】請求項３の発明によると、リーンNO_x触媒に吸収されるNO_xおよびSO_xの量を個別に推定するので、新たなセンサを設けることなくNO_xおよびSO_xの特徴に合わせた処理が行われ、触媒の機能を効率的に発揮させることができる。

【００１５】

【発明の実施の形態】次に図面を参照しながら、この発明の実施の形態を説明する。まずこの発明が適用されるエンジンの構造を説明すると、図１に示すようにエンジン１は、ピストン２、燃焼室３、点火プラグ４、吸気バルブ５、吸気ポート６、排気バルブ７、排気ポート８、および燃料を燃焼室に供給する燃料噴射装置すなわちインジェクタ１１を備えている。この図ではインジェクタ１１は、吸気ポート６に配置されているが、燃焼室に直接燃料を噴射するようエンジンのシリンダ内にノズルが露出するように配置されてもよい。

【００１６】吸気ポート６は、対応するマニホールド９を介してサージタンク１０に連結されている。サージタンク１０は、吸気ダクト１２を介してエアクリーナ１４に接続されている。サージタンク１０には吸気管圧力を測定する圧力センサ１３が接続されている。吸気ダクト１２内にはスロットル・バルブ１５が配置されており、開度センサ２３がスロットル・バルブ１５の開度を検知し開度に応じた信号を出力する。

【００１７】一方、排気マニホールド１６には、全域空燃比サンサ２２が接続されており、広い空燃比領域にわたって空燃比にほぼ比例した電圧出力を生成する。排気管１７にはＳＯｘを吸収するＳＯｘ触媒１８およびその下流に位置するＮＯｘを吸収するＮＯｘ触媒１９を内蔵したケーシング２０が設けられている。

【００１８】電子制御ユニットＥＣＵ３０は、コンピュータで構成され、コンピュータで実行するプログラムおよびデータを格納するＲＯＭ（リードオンリメモリ）、実行時に必要なプログラムおよびデータを取り出して記憶し、演算の作業領域を提供するＲＡＭ（ランダム・アクセス・メモリ）、プログラムを実行するＣＰＵ（プロセッサ）、および各種のセンサからの入力信号を処理する回路およびエンジン各部に制御信号を送る駆動回路を備える。図１ではこのようなハードウェア構成をふまえてＥＣＵ３０を機能ブロックで示してある。

【００１９】エンジンの負荷に対応する吸気管圧力を検知する圧力センサ１３の出力、スロットル・バルブの開度を検知するスロットル開度センサ２３の出力、排気ガスの空燃比を全域にわたって検出する全域空燃比センサ２２の出力、および触媒の温度を検出する温度センサ２１の出力は、ＥＣＵ３０の運転状態検出部３３に入力される。運転状態検出部３３は、車速センサ２６からの車速を示す信号および回転数センサ２５からエンジンの回転数Ｎｅを示す信号を受け取る。

【００２０】運転状態検出部３３は、上記のもののほか図示しないセンサの出力を受け取って処理し、吸気管圧力ＰＢ、スロットル・バルブの開度θ、車速Ｖ、エンジンの回転数Ｎｅ、排気ガス温、エンジン冷却水温、吸入空気温、大気圧などのパラメータ（以後、総合的にエンジン運転パラメータと呼ぶ。）をＥＣＵ３０の他の機能ブロックに提供する。

【００２１】点火時期制御部３６は、運転状態検出部３３から送られてくるエンジン運転パラメータに基づいて点火時期を制御する信号を図示しないディストリビュータまたはイグナイタに送り、点火プラグ４の点火を制御する。

【００２２】目標空燃比設定部３４は、運転状態検出部３３からエンジン回転数Ｎｅおよび吸気管圧力ＰＢの情報を受け取り、たとえば１３から４０の範囲の目標空燃比を求める。

【００２３】燃料噴射制御部３５は、運転状態検出部３３から送られてくる吸気管圧力ＰＢおよびエンジン回転数Ｎｅに基づいて燃料の基本噴射時間を求める。エンジンへの燃料の供給量はインジェクタ１１の弁が開かれる時間で決まる。この時間、すなわち燃料噴射時間Ｔｒは、$Tr = Tp \times Km \times Kc$で表される。Ｔpは、吸入空気質量から決定される基本噴射時間、Ｋｃは目標空燃比係数、Kmは、各センサからの信号により冷間時や加速時など、そのときのエンジン状態において適切な空燃比にするための補正を行う係数である。目標空燃比係数は、空燃比の逆数に比例する係数で、理論空燃比で1.0である。

【００２４】ここでは吸入空気質量を測定するのに吸気管圧力センサを使ったスピードデンシティ方式を用いているが、吸入空気質量を測定するのにマスフロー方式その他の方式を使う場合は、その方式に沿った噴射時間の算出手法を用いて燃料の噴射を制御する。

【００２５】ＥＣＵ３０には、NO_x触媒に吸収されるNO_xの量およびSO_x触媒に吸収され蓄積されるSO_xの量を推定する推定部３７（推定手段）が設けられている。NO_x触媒およびSO_x触媒に吸収されるNO_xおよびSO_xの量は、機関から排出される排気ガスの量と排気ガス中のNO_xおよびSO_xの濃度に比例する。排気ガス量は、吸入空気量に対応し、排気ガス中のNO_xおよびSO_xの濃度は、機関負荷に対応するので、NO_x触媒およびSO_x触媒にそれぞれ吸収されるNO_xおよびSO_xの量は、吸入空気量と機関負荷に対応する。したがって、触媒に吸収されたNO_x量およびSO_x量は、吸入空気量と機関負荷から推定することができる。

【００２６】図２は、推定部３７の構成を示すブロック図で、加算値決定部３７０が運転状態検出部３３で検出され一定周期でサンプリングされ数値化された吸気管圧力ＰＢと、同じく運転状態検出部３３で検出され一定周期でサンプリングされ数値化されたエンジンの回転数Ｎｅとを受け取り、これらに基づいてNO_xカウンタ３７２およびSO_xカウンタ３７３にそれぞれ加算すべき値を決定する。一つの形態として加算値決定部３７０は、吸気管圧力ＰＢとエンジン回転数Ｎｅとの積に応じてNO_xカウンタを進める値およびＳＯｘカウンタを進める値をテーブル３７１から取り出し、それぞれの値をNO_xカウンタ３７２およびＳＯｘカウンタ３７３に送る。

【００２７】または、カウンタに加算すべき値を求めるためのマップを用意しておき、吸気管圧力ＰＢおよびエンジン回転数Ｎｅからマップを参照してカウントを進める値を求めることもできる。この場合、このマップはテーブル３７１に格納される。カウントを進める値は、サンプリング期間中にNO_x触媒およびSO_x触媒に吸収されるNO_xおよびSO_xの量に対応する値である。

【００２８】NO_xは、排気ガス中に数百ｐｐｍのオーダーで流れて来てNO_x触媒内に短時間のうちに飽和するが、イオウほど反応力が強くないので理論空燃比14.7よりわずかにリッチな、ほぼ14.5以下の空燃比を用いて５秒程度以下の短時間で取り除くことができる。また、この場合、触媒の温度は触媒の活性温度（300℃程度）以上であれば十分である。

【００２９】これに対し、SO_xは、ガソリン中のイオウ濃度が300ｐｐｍ程度でも排気ガス中には高くても20～25ｐｐｍしか含まれないので、触媒内に飽和するまでには長時間がかかる。しかし、SO_xはNO_xより反応力

が強いので、その除去には600℃以上の高温が必要であり、空燃比はＮＯｘ除去の場合より濃くする必要がある。空燃比の値は、典型的には空燃比13.0以下で10分程度の時間にわたって実施するのがよい。

【００３０】比較回路３７４は、NO_xカウンタ３７２の値を、触媒内に吸収されたNO_xを除去すべきレベルに相当する第１基準値ｒｅｆ１と比較し、カウンタ３７２の値がｒｅｆ１に達すると、NO_x除去リッチ化要求信号ｓｐｋ１を燃料噴射制御部３５に送る。この第１基準値としては、触媒に余裕を持たせるため、NO_x触媒を飽和させる量より一定量少ない量に相当する値が予め設定されている。

【００３１】燃料噴射制御部３５は、このNO_x除去リッチ化要求信号ｓｐｋ１に応答し、その時のエンジン運転パラメータに基づいて短時間たとえばたとえば1.2秒間のリッチ化を実施する。この時使用するリッチ化の空燃比は理論空燃比よりややリッチなもの、たとえば14.0を用いる。これと同時に燃料噴射制御部３５は、NO_xカウンタ３７２にリセット信号ｒｓｔ１を送り、NO_xカウンタをリセットする。この場合、リセット信号ｒｓｔ１を加算値決定部３７０にも送り、NO_x除去のためのリッチ化によってSO_x触媒から除去されるSO_x量に相当するカウント値をSO_xカウンタ３７３への加算値から減算するようにしてもよい。

【００３２】比較回路３７５は、SO_xカウンタ３７３の値を、触媒内に吸収されたSO_xを除去すべきレベルに相当する第２基準値ｒｅｆ２と比較し、カウンタ３７３の値がｒｅｆ２に達すると、SO_x除去リッチ化要求信号ｓｐｋ２を燃料噴射制御部３５に送る。この第２基準値としては、触媒に余裕を持たせるため、SO_x触媒を飽和させる量より一定量少ない量に相当する値が予め設定されている。

【００３３】燃料噴射制御部３５は、このSO_x除去リッチ化要求信号ｓｐｋ２に応答し、その時のエンジン運転パラメータに基づいて比較的長時間、たとえば８分間のリッチ化を実施する。このリッチ化の空燃比はNO_x除去のために使用した空燃比よりも濃くし、たとえば空燃比11.0を使用する。これと同時にSO_xカウンタ３７３をリセットする信号ｒｓｔ２をカウンタ３７３に送り、カウンタ３７３をリセットする。この場合、SO_x除去のためのリッチ化は十分長くNO_x触媒からもNO_xが還元除去されるので、リセット信号ｒｓｔ２はNO_xカウンタ３７２にも送られ、カウンタ３７２をリセットする。

【００３４】図３は、この発明の一実施形態の処理の流れを示す流れ図である。図１の推定部３７でNO_x触媒１９およびSO_x触媒１８に吸収されるNO_xおよびSO_xの吸収量を推定し（S101）、先ずSO_xが飽和したかどうか判定し（S102）、飽和していなければNO_xが飽和したかどうか判定する（S103）。ここでは飽和という言葉を使っているが、触媒に余裕を持たせるため現実に飽和するよりも若干低い値を飽和値として判定する。

【００３５】NO_xの飽和が判定されるとNO_x除去用のリッチ化の空燃比および実施時間を決定し（S104）、実施する（S105）。リッチ化を実施すると同時にNO_xカウンタ３７２をリセットする（S106）。このとき、実施したリッチ化に相当する値だけSO_xカウンタ３７３を減算することが好ましい。

【００３６】ステップS102でSO_xの飽和が判定されると、SO_x除去用のリッチ化の空燃比および実施時間が算出され（S107）、触媒の温度がSO_x除去に有効な基準温度（600℃）以上であるかどうかが判定される（S108）。触媒温度が低い場合は、ステップS103に飛びNO_x除去のプロセスに入り、NO_x除去プロセス終了後、再びステップS101から開始する。

【００３７】ステップS108で触媒の温度が基準温度以上に達していると、リッチ化を実施し（S109）、完了と同時にSO_xカウンタ３７３およびNO_xカウンタ３７２をリセットする。ここでリッチ化は、目標空燃比係数Ｋｃを1.0より大きい値に設定することにより実施される。

【００３８】以上の実施形態は、NO_x触媒の上流にSO_x触媒を配置した排気ガス浄化装置に関するものであるが、この発明は、いわゆるリーンNO_x触媒だけを使用する排気ガス浄化装置についても適用することができる。この場合、リーンNO_x触媒に吸収されるNO_xおよびSO_xの量がそれぞれ推定され、個別に除去のための空燃比リッチ化が実施される。そのため、図２のSO_xカウンタ373は、リーンNO_x触媒に吸収されるSO_xの量に対応する値をカウントする。

【００３９】以上にこの発明の実施形態を説明したが、この発明はこのような実施形態に限定されるものではない。

【００４０】

【発明の効果】請求項１の発明は、NO_xおよびSO_xの触媒への吸収および還元特性の相違に着目し、反応力が強く触媒からの還元放出が容易でないSO_xを還元するためにNO_x還元のためのリッチ化より濃いリッチ化を、NO_x還元のためのリッチ化の実施とは異なる時間に供給するので、SO_xをその特性に応じて効率的に除去することができる。

【００４１】請求項２の発明は、内燃機関の吸入空気量および機関の回転数に基づいてNO_x触媒に吸蔵されたNO_xの量およびSO_x触媒に吸収されたSO_xの量をそれぞれ推定し、NO_x除去のための制御とSO_x除去のための制御とを個別に実施するので、新たなセンサを設けることなくNO_xおよびSO_xの特徴に合わせた処理が行われ、触媒の機能を効率的に発揮させることができる。

【００４２】請求項３の発明は、リーンＮＯｘ触媒に吸収されるＮＯｘおよびＳＯｘの量をそれぞれ推定し、NO_x除去のための制御とSO_x除去のための制御とを個別

に実施するので、新たなセンサを設けることなくＮＯ$_X$およびＳＯ$_X$の特徴に合わせた処理が行われ、触媒の機能を効率的に発揮させることができる。

【図面の簡単な説明】

【図１】この発明の実施例のエンジン装置の全体的構成を示す図。

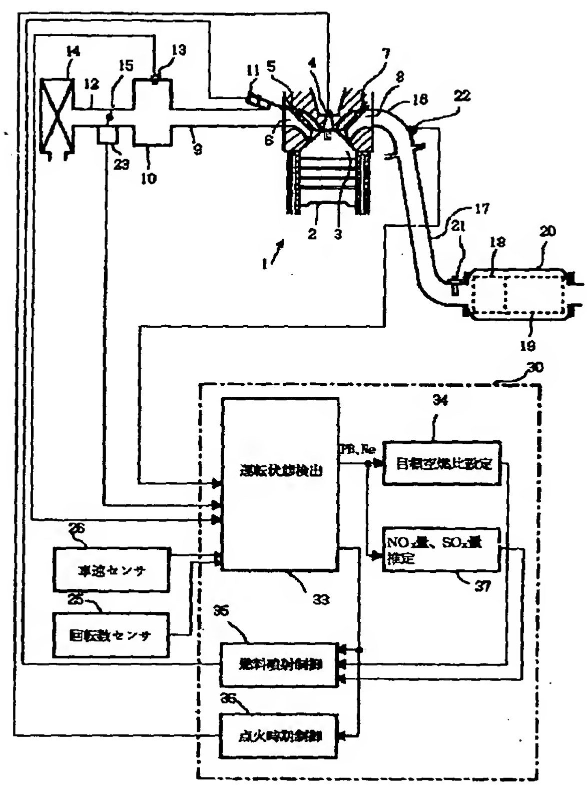
【図２】推定部３７の詳細を示すブロック図。

【図３】この発明の一実施形態における処理の流れを示す流れ図。

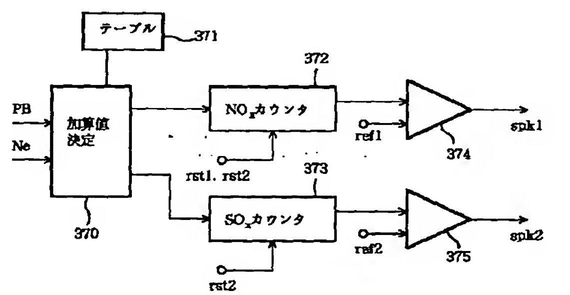
【符号の説明】

1	エンジン（内燃機関）
１１	インジェクタ（燃料噴射手段）
１８	ＳＯ$_X$触媒
１９	ＮＯ$_X$触媒
３５	燃料噴射制御部（燃料噴射制御手段）
３７	ＮＯ$_X$量、ＳＯ$_X$量推定部（推定手段）

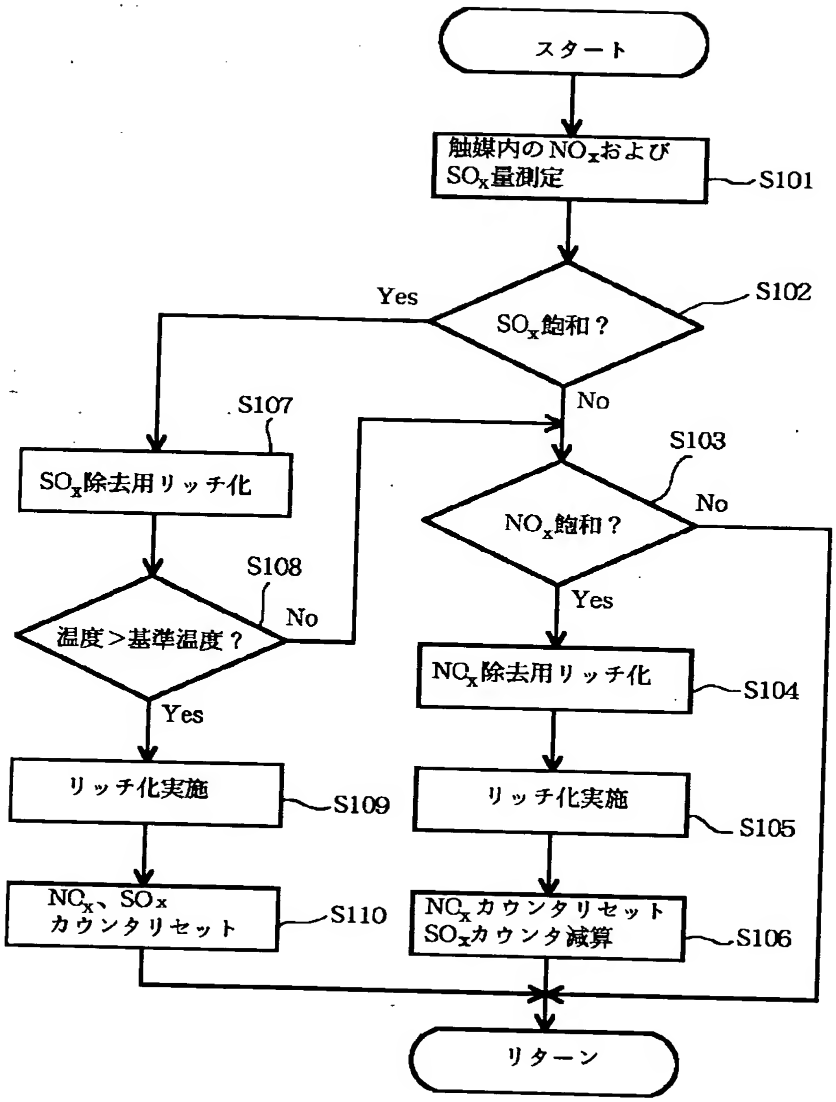
【図１】



【図２】



【図３】



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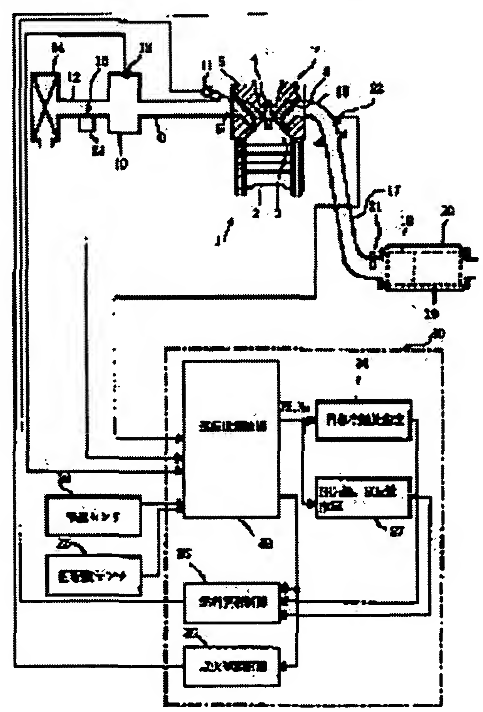
(54) EXHAUST EMISSION CONTROL DEVICE OF INTERNAL COMBUSTION ENGINE



(57)Abstract:

PROBLEM TO BE SOLVED: *To efficiently eliminate SOx according to its characteristic by controlling a fuel injection means to make the air fuel ratio supplied to an internal combustion engine more rich than the air fuel ratio when NOx is reduced in order to reduce SOx which has strong reaction force so that reduction release from a catalyst is not easy.*

SOLUTION: During the operation of an engine 1, the absorbed amounts of NOx and SOx absorbed in NOx catalyst 19 and SOx catalyst 18 are respectively estimated by an estimating party 37 in an ECU 30 to first determine whether SOx is saturated or not, and if NO, secondary it is determined whether NOx is saturated or not. If saturation of NOx is determined, making air fuel ratio rich and its execution time for eliminating NOx are decided to make rich. On the other hand, in the case where saturation of SOx is determined, making air fuel ratio rich and its execution time for eliminating SOx are calculated, and in the case where the temperature of a catalyst is below the reference temperature effective for eliminating SOx, it enters NOx

elimination process. However, in the case where the temperature of a catalyst is above the reference temperature, the ratio is made rich.

LEGAL STATUS

[Date of request for examination]

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[Date of registration]

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[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] The exhaust emission control device of the internal combustion engine which has the NOx catalyst which is prepared in the exhaust air system of an internal combustion engine characterized by providing the following, and absorbs NOx at the time of operation with a RIN air-fuel ratio, and the SOx catalyst which is prepared in the upstream of this RIN NOx catalyst, and absorbs SOx at the time of RIN. A fuel-injection means to supply fuel to the aforementioned internal combustion engine. Fuel-injection control means which control the aforementioned fuel-injection means to make more rich than theoretical air fuel ratio the air-fuel ratio supplied to the aforementioned internal combustion engine in order to make NOx absorbed by the aforementioned NOx catalyst return, and to make more rich than the air-fuel ratio at the time of making NOx return the air-fuel ratio supplied to the aforementioned internal combustion engine in order to return SOx absorbed by the aforementioned SOx catalyst.
[Claim 2] The exhaust emission control device of the internal combustion engine which has the NOx catalyst which is prepared in the exhaust air system of an internal combustion engine characterized by providing the following, and absorbs NOx at the time of operation with a RIN air-fuel ratio, and the SOx catalyst which is prepared in the upstream of this RIN NOx catalyst, and absorbs SOx at the time of RIN. A presumed means to presume the amount of SOx absorbed by the amount and the aforementioned SOx catalyst of NOx which were absorbed by the aforementioned NOx catalyst based on the load of the aforementioned internal combustion engine, and an engine's rotational frequency, respectively. It embraces that the state where the amount of NOx presumed by fuel-injection means to supply fuel to the aforementioned internal combustion engine, and the aforementioned presumed means approached saturation is judged. The time suitable for removing NOx and the air-fuel ratio supplied to an internal combustion engine are made more rich than theoretical air fuel ratio. An injection fuel-control means to control the aforementioned fuel-injection means to make the time suitable for removing SOx, and the air-fuel ratio supplied to an internal combustion engine more rich than theoretical air fuel ratio according to the state where the amount of SOx approached saturation by the aforementioned presumed means being judged.
[Claim 3] The exhaust emission control device of the internal combustion engine which has the RIN NOx catalyst which is characterized by providing the following, and which is prepared in the exhaust air system of an internal combustion engine, and absorbs NOx at the time of operation with a RIN air-fuel ratio. A presumed means to presume the amount of NOx and the amount of SOx which were absorbed by the aforementioned RIN NOx catalyst based on the load of the aforementioned internal combustion engine, and an engine's rotational frequency, respectively. It embraces that the state where the amount of NOx presumed by fuel-injection means to supply fuel to the aforementioned internal combustion engine, and the aforementioned presumed means approached saturation is judged. The time suitable for removing NOx and the air-fuel ratio supplied to an internal combustion engine are made more rich than theoretical air fuel ratio. An injection fuel-control means to control the aforementioned fuel-injection means to make the time suitable for removing SOx, and the air-fuel ratio supplied to an internal combustion engine more rich than theoretical air fuel ratio according to the state where the amount of

SOx approached saturation by the aforementioned presumed means being judged.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the exhaust emission control device which specifically raises the purification function of NOx and SOx which are generated with an internal combustion engine about the exhaust emission control device of the RIN barn internal combustion engine operated with a RIN air-fuel ratio.
[0002]
[Description of the Prior Art] Adsorption or the RIN NOx catalyst which carries out occlusion and carries out reduction purification of adsorption or the NOx which carried out occlusion at the time of rich or theoretical air fuel ratio is used in NOx discharged in the internal combustion engine it was made to burn fuel at the time of RIN with a RIN air-fuel ratio. There is a thing of the following two methods in a RIN NOx catalyst.
[0003] The thing of the 1st method is called a NOx adsorption method or direct decomposition method, makes a zeolite and an alumina support high-melting point noble metals, and is formed. making Pt, Ir, and Rh composite-ize as noble metals -- Pt -- it compares independently and it is reported that the RIN NOx purification effect and thermal resistance can be raised ("environmental correspondence [of an automobile prime mover] technical" Asakura Publishing Co., Ltd., July 10, 1997, p60) The NOx cleaning effect of this catalyst is considered as follows. Although NOx contained in combustion gas adsorbs on the surface of noble metals, if HC concentration becomes high, the oxygen generated by decomposition of NOx on a noble-metals front face will be returned by HC. In this way, decomposition of NOx is promoted and purified. This catalyst has not only a RIN NOx purification property but the general three-way-component-catalyst property.
[0004] The thing of the 2nd method is called NOx occlusion reduction type, and high distribution support of the salt of Pt system noble metals, alkali, such as Ba and La, an alkaline earth, and rare earth is carried out at support, such as an alumina. According to this catalyst, NO discharged at the time of RIN oxidizes to NO2 on Pt front face, and occlusion is carried out to an occlusion component as a nitrate (NO3-) (above-shown "environmental correspondence [of an automobile prime mover] technical" p61). Next, if an air-fuel ratio is richly controlled from theoretical air fuel ratio, Occlusion NOx will be returned by gas, such as HC, CO, and H2, and it will be removed. It also has the three-way-component-catalyst property also with this common catalyst.
[0005] Thus, a RIN NOx catalyst is adsorption or a thing which carries out occlusion, decomposes or returns, and is removed at the time of rich about NOx generated at the time of RIN. Thus, it calls it absorption to adsorb or carry out occlusion and to hold NOx.
[0006] However, since sulfur is contained in the lubricating oil of fuel and an internal combustion engine, SOx is contained in exhaust gas. Although absorbed by the RIN NOx catalyst with NOx, this SOx is unremovable even if it makes an air-fuel ratio rich for NOx removal. Therefore, the amount of SOx absorbed by the RIN NOx catalyst increases gradually, and the absorptance of NOx is reduced.
[0007] As a thing corresponding to this problem, while arranging a SOx absorbent (henceforth a SOx

catalyst) for the upstream of a RIN NOx catalyst in the exhaust air system of an internal combustion engine and absorbing SOx in exhaust gas for a SOx catalyst in a RIN barn state, absorbing NOx in exhaust gas for a RIN NOx catalyst is indicated by JP,6-229230,A. This SOx catalyst carries out oxidation reduction of the SOx absorbed when the air-fuel ratio of exhaust gas was RIN, SOx was absorbed and exhaust gas became rich, and emits it. In case the technique indicated by this official report makes an air-fuel ratio rich, it has proposed asking for the rich degree which HC is consumed in a SOx catalyst and decreases, increasing that much rich degree, and controlling exhaust gas richly.
[0008]
[Problem(s) to be Solved by the Invention] The technique of JP,6-229230,A is not taken into consideration at all about the timing to which SOx is made to emit from a SOx catalyst, the timing to which NOx is made to emit from a NOx catalyst, and a rich degree. Then, this invention aims at offering the exhaust air gas cleanup equipment from which NOx and SOx which are contained in exhaust gas are removed effectively.
[0009]
[Means for Solving the Problem] The NOx catalyst which is prepared in the exhaust air system of an internal combustion engine, and absorbs NOx at the time of operation with a RIN air-fuel ratio in order that invention of a claim 1 may solve the above-mentioned technical problem, And it sets to the exhaust emission control device of the internal combustion engine which has the SOx catalyst which is prepared in the upstream of this RIN NOx catalyst, and absorbs SOx at the time of RIN. The air-fuel ratio supplied to the aforementioned internal combustion engine in order to make a fuel-injection means to supply fuel to an internal combustion engine, and NOx absorbed by the NOx catalyst return is made more rich than theoretical air fuel ratio. In order to return SOx absorbed by the aforementioned SOx catalyst, composition equipped with the fuel-injection control means which control a fuel-injection means to make more rich than the air-fuel ratio at the time of making NOx return the air-fuel ratio supplied to an internal combustion engine is taken.
[0010] Since according to this invention it supplies at time to differ from rich-ization for NOx reduction of the fuel of an air-fuel ratio much more more rich than the rich air-fuel ratio for NOx reduction paying attention to the absorption to the catalyst of NOx and SOx, and a difference of a reduction property in order to return SOx for which whose reaction force is strong and the reduction discharge from a catalyst is not easy, SOx is efficiently removable according to the property.
[0011] The NOx catalyst which invention of a claim 2 is prepared in the exhaust air system of an internal combustion engine, and absorbs NOx at the time of operation with a RIN air-fuel ratio, And it sets to the exhaust emission control device of the internal combustion engine which has the SOx catalyst which is prepared in the upstream of this RIN NOx catalyst, and absorbs SOx at the time of RIN. A presumed means to presume the amount of SOx absorbed by the amount and the aforementioned SOx catalyst of NOx which were absorbed by the aforementioned NOx catalyst based on the load of an internal combustion engine, and an engine's rotational frequency, respectively, It embraces that the state where the amount of NOx presumed by fuel-injection means to supply fuel to an internal combustion engine, and the presumed means approached saturation is judged. The time suitable for removing NOx and the air-fuel ratio supplied to an internal combustion engine are made more rich than theoretical air fuel ratio. Composition equipped with an injection fuel-control means to control a fuel-injection means to make the time suitable for removing SOx and the air-fuel ratio supplied to an internal combustion engine more rich than theoretical air fuel ratio according to the state where the amount of SOx approached saturation by the presumed means being judged is taken.
[0012] Invention of a claim 2 presumes the state where SOx absorbed by the state where NOx by which occlusion was carried out to the NOx catalyst based on the inhalation air content of an internal combustion engine and an engine's rotational frequency is saturated, and the SOx catalyst is saturated. Since control for NOx removal and control for SOx removal are carried out individually, processing doubled with the feature of NOx and SOx is performed without forming a new sensor, and the function of a catalyst can be demonstrated efficiently.
[0013] In the exhaust emission control device of the internal combustion engine which has the RIN NOx

catalyst which invention of a claim 3 is prepared in the exhaust air system of an internal combustion engine, and absorbs NOx at the time of operation with a RIN air-fuel ratio A presumed means to presume the amount of NOx and the amount of SOx which were absorbed by the aforementioned NOx catalyst based on the load of an internal combustion engine, and an engine's rotational frequency, respectively, It embraces that the state where the amount of NOx presumed by fuel-injection means to supply fuel to an internal combustion engine, and the presumed means approached saturation is judged. The time suitable for removing NOx and the air-fuel ratio supplied to an internal combustion engine are made more rich than theoretical air fuel ratio. Composition equipped with an injection fuel-control means to control a fuel-injection means to make the time suitable for removing SOx and the air-fuel ratio supplied to an internal combustion engine more rich than theoretical air fuel ratio according to the state where the amount of SOx approached saturation by the presumed means being judged is taken.
[0014] Since the amount of NOx and SOx which are absorbed by the RIN NOx catalyst is presumed individually according to invention of a claim 3, processing doubled with the feature of NOx and SOx is performed without forming a new sensor, and the function of a catalyst can be demonstrated efficiently.
[0015]
[Embodiments of the Invention] Next, the gestalt of implementation of this invention is explained, referring to a drawing. If the structure of an engine where this invention is applied first is explained, the engine 1 is equipped with the fuel injection equipment 11, i.e., injector, which supplies a piston 2, a combustion chamber 3, an ignition plug 4, the inhalation-of-air bulb 5, a suction port 6, the exhaust air bulb 7, the exhaust air port 8, and fuel to a combustion chamber as shown in drawing 1 . In this drawing, although arranged at the suction port 6, an injector 11 may be arranged so that direct fuel may be injected to a combustion chamber and a nozzle may be exposed in the cylinder of an engine.
[0016] The suction port 6 is connected with the surge tank 10 through the corresponding manifold 9. The surge tank 10 is connected to the air cleaner 14 through the air intake duct 12. The pressure sensor 13 which measures the pressure-of-induction-pipe force is connected to the surge tank 10. The throttle valve 15 is arranged in the air intake duct 12, and the opening sensor 23 detects the opening of a throttle valve 15, and outputs the signal according to opening.
[0017] On the other hand, all-over-the-districts air-fuel ratio SANSA 22 is connected to the exhaust manifold 16, and the voltage output which is proportional to an air-fuel ratio mostly over a latus air-fuel ratio field is generated. The casing 20 which built the NOx catalyst 19 which absorbs NOx located in the SOx catalyst 18 which absorbs SOx, and its lower stream of a river in the exhaust pipe 17 is formed.
[0018] Electronic control unit ECU30 consists of computers, takes out and memorizes a program and data required at the time of ROM (read-only memory) and the execution which store the program and the data which are performed by computer, and equips RAM (random access memory) which offers the working area of an operation, CPU (processor) which executes a program, the circuit which processes the input signal from various kinds of sensors, and each part of an engine with the drive circuit to which a control signal is sent. In drawing 1 , functional block has shown ECU30 based on such hardware composition.
[0019] The output of the pressure sensor 13 which detects the pressure-of-induction-pipe force corresponding to the load of an engine, the output of the throttle opening sensor 23 which detects the opening of a throttle valve, the output of the all-over-the-districts air-fuel ratio sensor 22 which detects the air-fuel ratio of exhaust gas over the whole region, and the output of the temperature sensor 21 which detects the temperature of a catalyst are inputted into the operational status detecting element 33 of ECU30. The operational status detecting element 33 receives the signal which shows the rotational frequency Ne of an engine from the signal and the rotational frequency sensor 25 in which the vehicle speed from the vehicle speed sensor 26 is shown.
[0020] The operational status detecting element 33 receives and processes the output of the above-mentioned sensor which is not thing-others-illustrated, and provides other functional block of ECU30 with parameters (it is henceforth called an engine operation parameter synthetically.), such as the pressure-of-induction-pipe force PB, the opening theta of a throttle valve, the vehicle speed V, the rotational frequency Ne of an engine, an exhaust gas temperature, engine-coolant water temperature,

inhalation sky atmospheric temperature, and atmospheric pressure.
[0021] The ignition-timing control section 36 is sent to the distributor or ignitor which does not illustrate the signal which controls ignition timing based on the engine operation parameter sent from the operational status detecting element 33, and controls ignition to an ignition plug 4.
[0022] The target air-fuel ratio setting section 34 receives the information on an engine speed Ne and the pressure-of-induction-pipe force PB from the operational status detecting element 33, for example, asks for the target air-fuel ratio of the range of 13-40.
[0023] The fuel-injection control section 35 finds the basic injection time of fuel based on the pressure-of-induction-pipe force PB and engine speed Ne which are sent from the operational status detecting element 33. The amount of supply of the fuel to an engine is decided in time when the valve of an injector 11 is opened. This time Tr, i.e., fuel injection duration, is expressed with Tr=Tp x Km x Kc. It is the coefficient which performs amendment for setting the basic injection time when Tp is determined from inhalation air mass, and Kc with the signal from each sensor for a target air-fuel ratio coefficient, setting Km in the engine state at those times, such as the time of acceleration between the colds, and making it a suitable air-fuel ratio. A target air-fuel ratio coefficient is a coefficient proportional to the inverse number of an air-fuel ratio, and is 1.0 in theoretical air fuel ratio.
[0024] Although the speed density method using the pressure-of-induction-pipe force sensor is used for measuring inhalation air mass here, when using to measure inhalation air mass the method of a mass-flow method and others, injection of fuel is controlled using the calculation technique of injection time in which the method was met.
[0025] The presumed section 37 (presumed means) which presumes the amount of SOx which is absorbed by the amount and SOx catalyst of NOx which are absorbed by the NOx catalyst, and is accumulated is formed in ECU30. The amount of NOx and SOx which are absorbed by a NOx catalyst and the SOx catalyst is proportional to the amount of the exhaust gas discharged by the engine, and the concentration of NOx and SOx in exhaust gas. Since exhaust air capacity corresponds to an inhalation air content and the concentration of NOx and SOx in exhaust gas is equivalent to an engine load, the amount of NOx and SOx which are absorbed by a NOx catalyst and the SOx catalyst, respectively is equivalent to an inhalation air content and an engine load. Therefore, the amount of NOx(es) and the amount of SOx(es) which were absorbed by the catalyst can be presumed from an inhalation air content and an engine load.
[0026] It is the block diagram showing the composition of the presumed section 37, the aggregate value determination section 370 is detected by the operational status detecting element 33, and drawing 2 receives the pressure-of-induction-pipe force PB which was sampled the fixed period and evaluated, and the rotational frequency Ne of the engine which was similarly detected by the operational status detecting element 33, was sampled the fixed period, and was evaluated, and determines the value which should be added to the NOx counter 372 and the SOx counter 373 based on these, respectively. As one gestalt, the aggregate value determination section 370 takes out the value which advances the value and SOx counter which advance a NOx counter according to the product of the pressure-of-induction-pipe force PB and an engine speed Ne from a table 371, and sends each value to the NOx counter 372 and the SOx counter 373.
[0027] Or the map for calculating the value which should be added to a counter is prepared, and the value which advances a count with reference to a map from the pressure-of-induction-pipe force PB and an engine speed Ne can also be calculated. In this case, this map is stored in a table 371. The value which advances a count is a value corresponding to the amount of NOx and SOx which are absorbed by a NOx catalyst and the SOx catalyst during the sampling.
[0028] Although NOx flows to hundreds of ppm order in exhaust gas and is saturated in a NOx catalyst in the inside of a short time, since the reaction force is not so strong as sulfur, it can be removed in a short time for about 5 or less seconds using about 14.5 or less air-fuel ratio slightly more rich than theoretical air fuel ratio 14.7. Moreover, it is enough if the temperature of a catalyst is more than the activity temperature (about 300 degrees C) of a catalyst in this case.
[0029] On the other hand, SOx will require a long time, before being saturated in a catalyst, since only

20-25 ppm of sulfur concentration in a gasoline are not contained even if at least about 300 ppm are high in exhaust gas. However, since the reaction force is stronger than NOx, SOx needs the elevated temperature of 600 degrees C or more for the removal, and needs to make an air-fuel ratio deeper than the case of NOx removal. As for the value of an air-fuel ratio, it is good to carry out over the time for about 10 minutes with 13.0 or less air-fuel ratio typically.

[0030] A comparator circuit 374 will send the NOx removal rich-ized demand signal spk1 to the fuel-injection control section 35, if the value of a counter 372 amounts to ref1 as compared with the 1st reference value ref1 equivalent to the level which should remove NOx absorbed in the catalyst in the value of the NOx counter 372. the amount which saturates a NOx catalyst as this 1st reference value in order to give a margin to a catalyst -- a constant rate -- the value equivalent to a few amount is set up beforehand

[0031] The fuel-injection control section 35 answers this NOx removal rich-ized demand signal spk1, and carries out a short time, for example, rich-izing for 1.2 seconds, based on the engine operation parameter at that time. The air-fuel ratio of rich-izing used at this time uses what is a little more rich than theoretical air fuel ratio, 14.0 [for example,]. Simultaneously with this, the fuel-injection control section 35 sends a reset signal rst1 to the NOx counter 372, and resets a NOx counter. In this case, a reset signal rst1 is sent also to the aggregate value determination section 370, and you may make it subtract the counted value equivalent to the amount of SOx(es) removed from a SOx catalyst by rich-ization for NOx removal from the aggregate value to the SOx counter 373.

[0032] A comparator circuit 375 will send the SOx removal rich-ized demand signal spk2 to the fuel-injection control section 35, if the value of a counter 373 amounts to ref2 as compared with the 2nd reference value ref2 equivalent to the level which should remove SOx absorbed in the catalyst in the value of the SOx counter 373. the amount which saturates a SOx catalyst as this 2nd reference value in order to give a margin to a catalyst -- a constant rate -- the value equivalent to a few amount is set up beforehand

[0033] The fuel-injection control section 35 answers this SOx removal rich-ized demand signal spk2, and carries out rich-ization between long times, for example, 8 minutes, comparatively based on the engine operation parameter at that time. The air-fuel ratio of this rich-izing is made deeper than the air-fuel ratio used for NOx removal, for example, uses an air-fuel ratio 11.0. The signal rst2 which resets the SOx counter 373 simultaneously with this is sent to a counter 373, and a counter 373 is reset. In this case, since rich-izing for SOx removal is sufficiently long and reduction removal of the NOx is carried out also from a NOx catalyst, a reset signal rst2 is sent also to the NOx counter 372, and resets a counter 372.

[0034] Drawing 3 is the flow chart showing the flow of processing of 1 operation gestalt of this invention. The absorbed dose of NOx and SOx which are absorbed by the NOx catalyst 19 and the SOx catalyst 18 in the presumed section 37 of drawing 1 is presumed (S101), and it judges whether SOx was saturated first (S102), and if not saturated, it judges whether NOx was saturated or not (S103). Although the word "saturation" is used here, in order to give a margin to a catalyst, a low value is judged as a saturation value a little rather than it is saturated actually.

[0035] A judgment of the saturation of NOx decides on them and (S104) carries out the air-fuel ratio and operation time of rich-izing for NOx removal (S105). The NOx counter 372 is reset at the same time it carries out rich-ization (S106). At this time, it is desirable that only the value equivalent to carried-out rich-ization subtracts the SOx counter 373.

[0036] If the saturation of SOx is judged at Step S102, the air-fuel ratio and operation time of rich-izing for SOx removal will be computed (S107), and it will be judged whether it is more than reference temperature (600 degrees C) with the temperature of a catalyst effective in SOx removal (S108). The degree of catalyst temperature flies to Step S103, goes into the process of NOx removal, and starts a low case from Step S101 again after a NOx removal process end.

[0037] If the temperature of a catalyst has reached at Step S108 more than reference temperature, rich-ization will be carried out (S109) and the SOx counter 373 and the NOx counter 372 will be reset simultaneously with completion. Rich-ization is carried out here by setting the target air-fuel ratio

coefficient Kc as a larger value than 1.0.

[0038] Although the above operation gestalt is related with the exhaust air gas cleanup equipment which has arranged the SOx catalyst for the upstream of a NOx catalyst, this invention is applicable also about the exhaust air gas cleanup equipment which uses only the so-called RIN NOx catalyst. In this case, the amount of NOx and SOx which are absorbed by the RIN NOx catalyst is presumed, respectively, and air-fuel ratio rich-ization for removal is carried out individually. Therefore, the SOx counter 373 of drawing 2 counts the value corresponding to the amount of SOx absorbed by the RIN NOx catalyst.

[0039] Although the operation gestalt of this invention was explained above, this invention is not limited to such an operation gestalt.

[0040]

[Effect of the Invention] Since invention of a claim 1 supplies rich-ization deeper than rich-izing for NOx reduction at time to differ from implementation of rich-izing for NOx reduction paying attention to the absorption to the catalyst of NOx and SOx, and a difference of a reduction property in order to return SOx for which whose reaction force is strong and the reduction discharge from a catalyst is not easy, it can remove SOx efficiently according to the property.

[0041] Invention of a claim 2 presumes the amount of SOx absorbed by the amount and SOx catalyst of NOx by which occlusion was carried out to the NOx catalyst based on the inhalation air content of an internal combustion engine, and an engine's rotational frequency, respectively. Since control for NOx removal and control for SOx removal are carried out individually, processing doubled with the feature of NOx and SOx is performed without forming a new sensor, and the function of a catalyst can be demonstrated efficiently.

[0042] Since invention of a claim 3 presumes the amount of NOx and SOx which are absorbed by the RIN NOx catalyst, respectively and carries out individually control for NOx removal, and control for SOx removal, processing doubled with the feature of NOx and SOx is performed without forming a new sensor, and it can demonstrate the function of a catalyst efficiently.

[Translation done.]

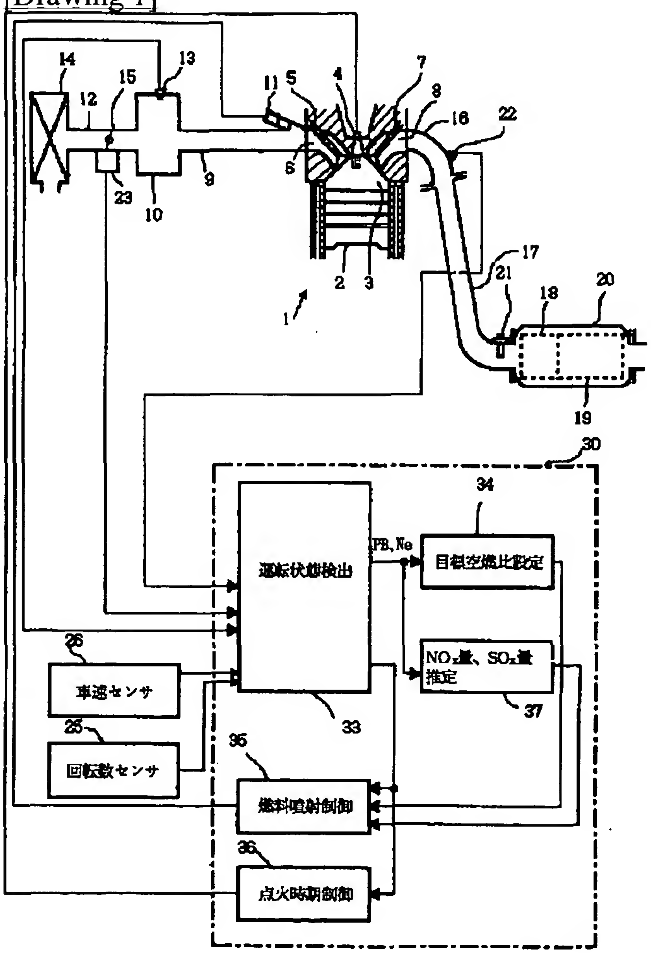
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing showing the overall composition of the engine equipment of the example of this invention.
[Drawing 2] The block diagram showing the detail of the presumed section 37.
[Drawing 3] The flow chart showing the flow of the processing in 1 operation gestalt of this invention.
[Description of Notations]
1 Engine (Internal Combustion Engine)
11 Injector (Fuel-Injection Means)
18 SOx Catalyst
19 NOx Catalyst
35 Fuel-Injection Control Section (Fuel-Injection Control Means)
37 The Amount of NOx(es), the Amount Presumption Section of SOx(es) (Presumed Means)

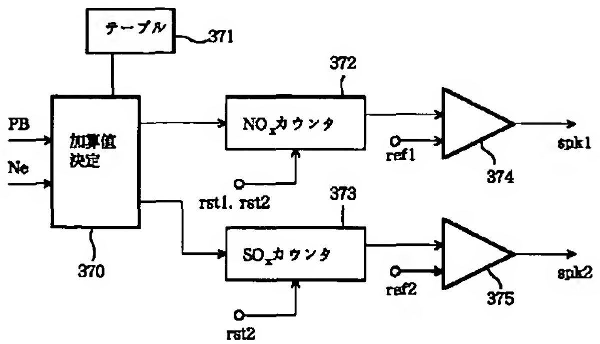
[Translation done.]

DRAWINGS

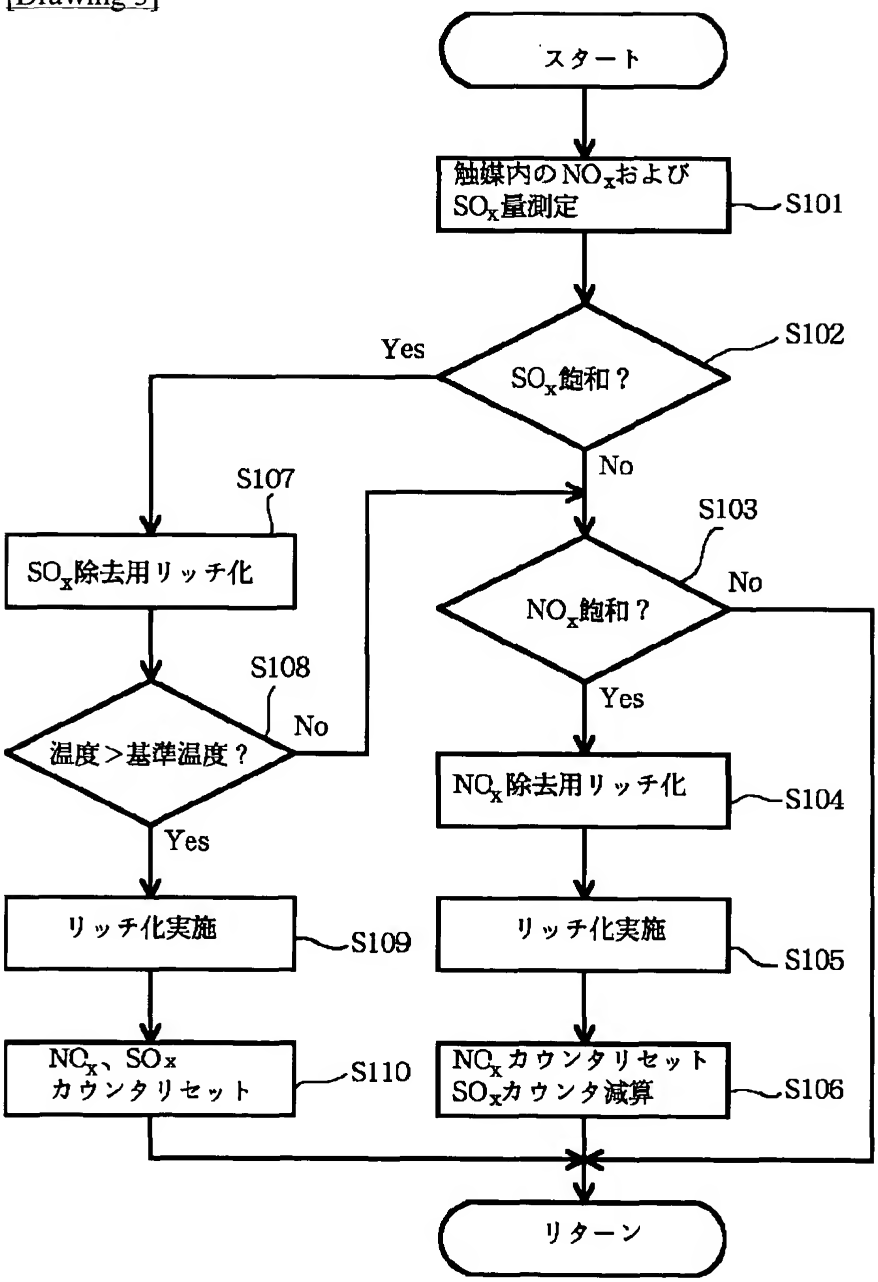
[Drawing 1]



[Drawing 2]


テーブル
371
372
PB
Ne
加算値
決定
NO$_x$カウンタ
ref1
spk1
374
rst1. rst2
373
370
SO$_x$カウンタ
ref2
spk2
375
rst2

[Drawing 3]


スタート
触媒内のNO$_x$および
SO$_x$量測定
S101
S102
Yes
SO$_x$飽和？
No
S107
S103
SO$_x$除去用リッチ化
No
NO$_x$飽和？
S108
No
温度＞基準温度？
Yes
NO$_x$除去用リッチ化
S104
Yes
リッチ化実施
S109
リッチ化実施
S105
NO$_x$、SO$_x$
カウンタリセット
S110
NO$_x$カウンタリセット
SO$_x$カウンタ減算
S106
リターン

[Translation done.]